Trim coil effect of EBIS MEBIT quad

2.22.2007
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1. Modified design of the EBIS MEBIT quad

The base model was modified from original Wuzheng Meng's design of EBIS MEBIT Q magnet. The thickness was revised from 2 x 3.334 cm to 2 x 4.0 cm to reduce saturation and also the outer dimension was enlarged about 20 % (8.99 to 11.0 cm, from the center to the outer surface, see fig. 1) to reduce a field leakage. The thicker yoke reduces the operating current from 2710A/cm2 to 2257A/cm2 to give same g x l value. The coil size was remained as 0.66 x 4.7 cm. Also the aperture radius was conserved as 1.66 cm.

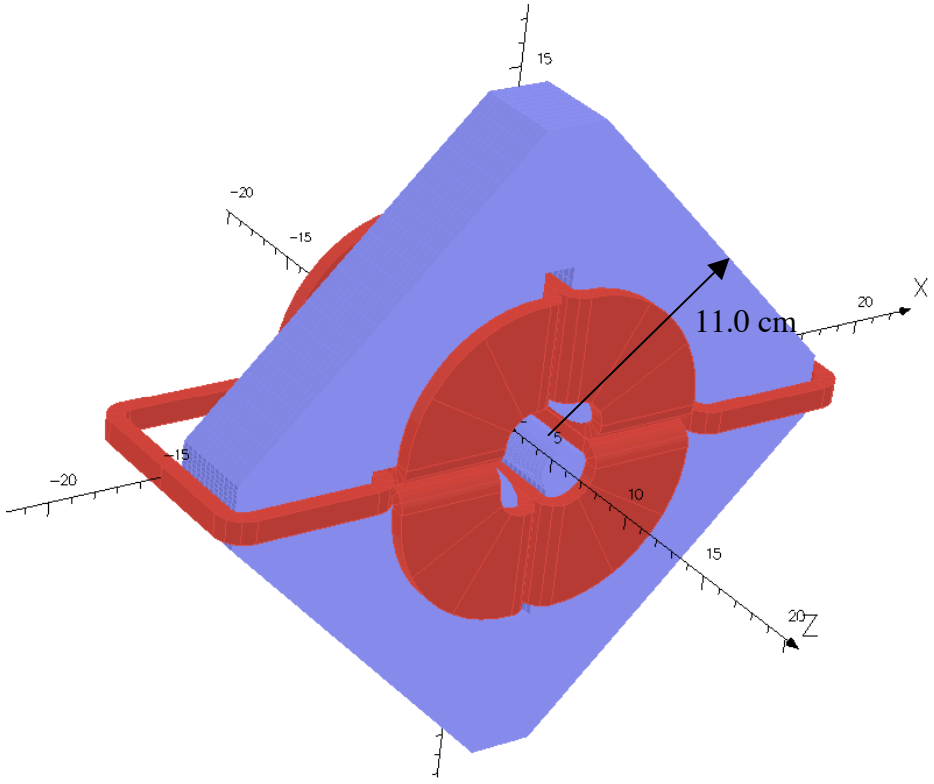

Fig. 1

To accommodate new trim coils, the yoke shape was slightly changed. The trim coil cross section is 0.7 x 1.0 cm which has 200A/cm2 current flow.

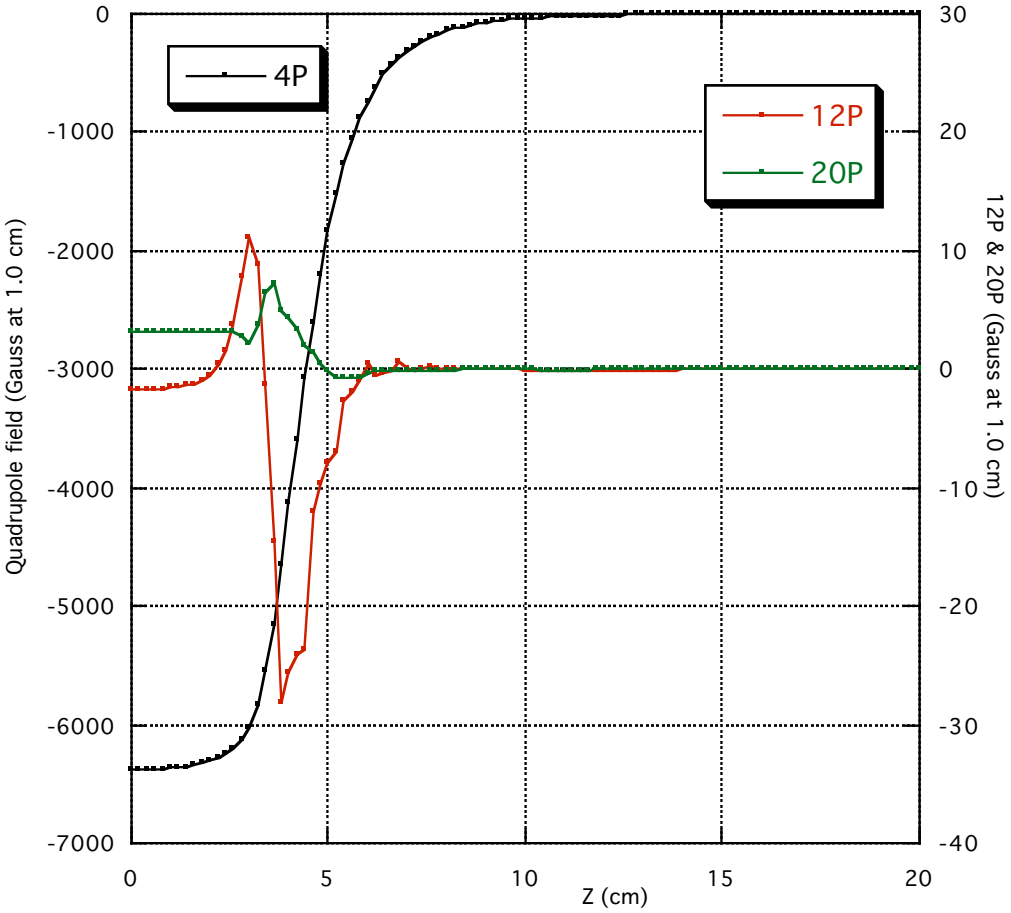

Fig.2 Field distribution of the base model.

The field gradient was estimated as 6.377 kGauss/cm and the effective length is 9.35 cm.

2. Using TOSCA, 5 models were calculated.

- Full current (Base model)
- Full current with trim coil
- Half current
- Half current with trim coil
- Only trim coil

3. Deflection angle due to the trim coil

Assuming Au32+ particle which has 300 KeV/u, 100 Gauss 10 cm dipole field gives 2.0 mrad deflection angle. The trim coil field induce 240 Gauss with 13.5cm effective length. This value corresponds to 6.4 mrad.

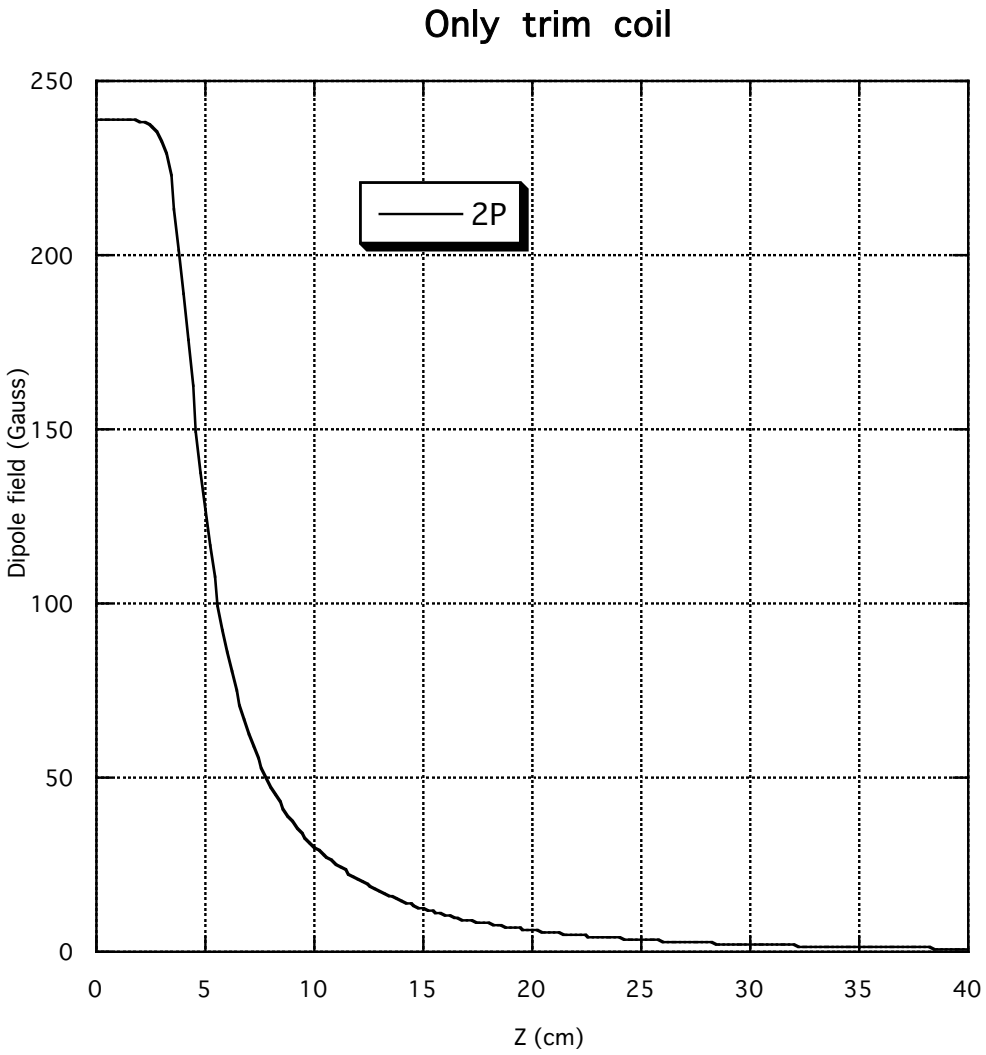

Fig. 3

4. The effect of the trim coil field to the main Q field

No effect was observed for the half main current model and less than 0.1 % effect to the full current model.

5. Sextupole component

Comparing to the dipole component, the sextupole is very large. Due to the shape of the poles, however no manipulation of the trim field quality can be applied.

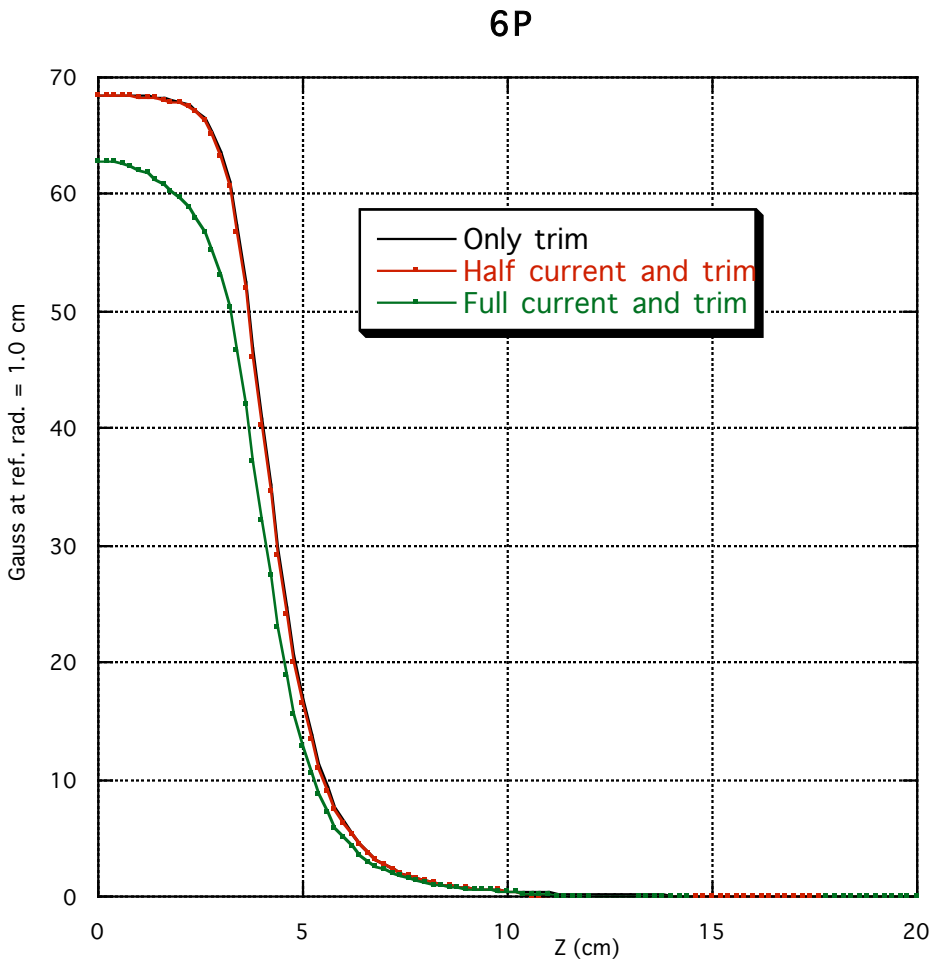

Fig. 4

Only trim	623 Gauss cm
Half current and trim	617 Gauss cm
Full current and trim	534 Gauss cm

The reference radius was set to 1.0 cm.

6. Decapole component

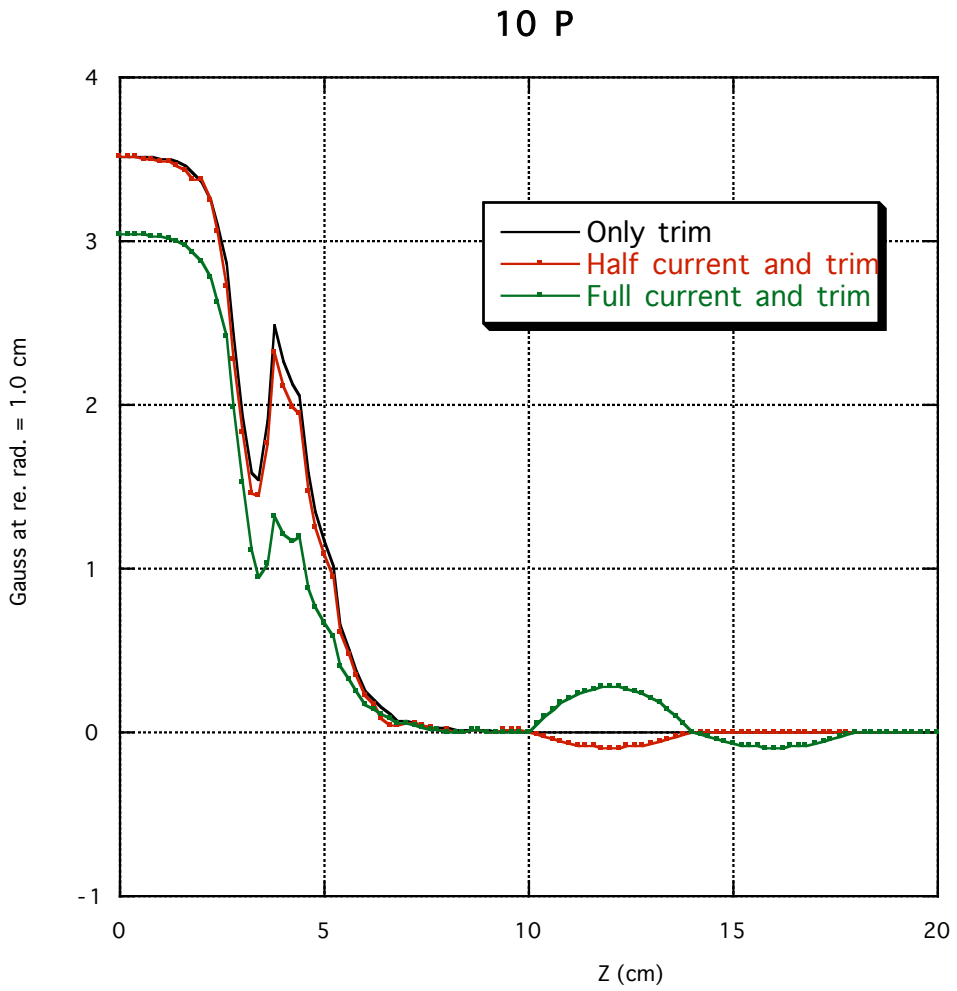

Fig. 5

Only trim	29.5 Gauss cm
Half current and trim	28.0 Gauss cm
Full current and trim	23.8 Gauss cm

The reference radius was set to 1.0 cm.

7. Multipole table

The reference radius is 1.0 cm. The unit is in Gauss cm.
The values are integrated along the axis, from -20 cm to 20 cm.

	2P	4P	6P	10P	12P	14P	18P	20P
Trim	3126		623	29.5		-5.27	-1.45	
Half current		-30581			-39.8			15.9
Half and trim	3105	-30581	617	28.0	-39.6	-4.77	-1.10	15.9
Full current		-59639			-56.7			31.3
Full and trim	2784	-59612	534	23.8	-56.5	-6.38	-0.93	31.9

A 0.1 mm offset of the magnet produces about 600 Gauss cm dipole component which corresponds to 1.2 mrad of the deflection angle.